

# Aerogel Analysis Meeting

Will Flanagan, Dung Phan, Brandon Soubasis

21 April, 2016

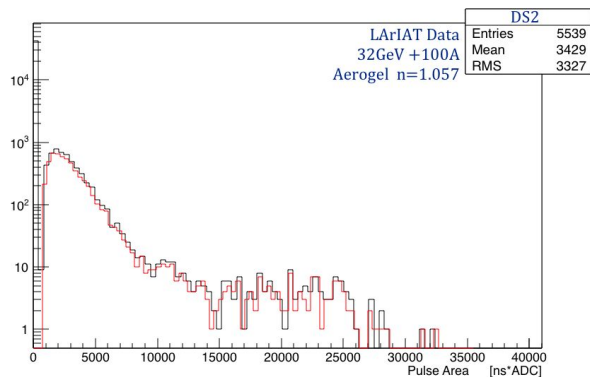
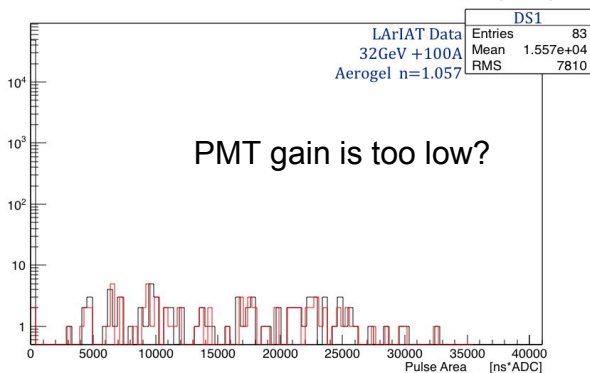
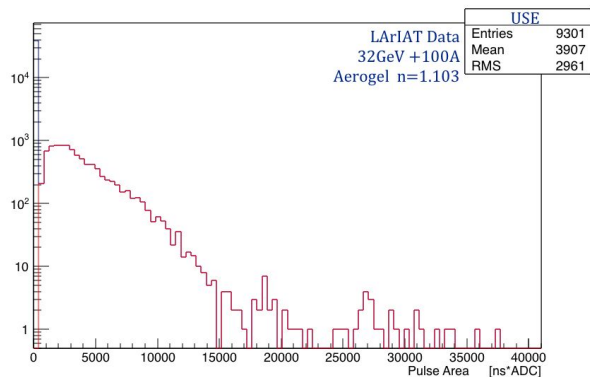
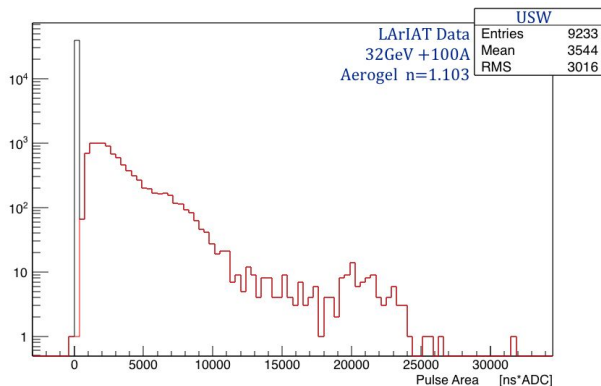


# Aerogel

- ❖ Instructions used to produce analysis using [LArSoft](#)  
<https://cdcvs.fnal.gov/redmine/projects/lardbt/wiki/AGCodes>
- ❖ Our naming convention for the four aerogel PMTs is:
  - US E/W are the two PMTs for the KEK counter (Hamamatsu H1161)
  - DS 1 is (the 3" square Photonis XP5382 PMT)
  - DS 2 is (the 2" circular EMI 9954B PMT.)

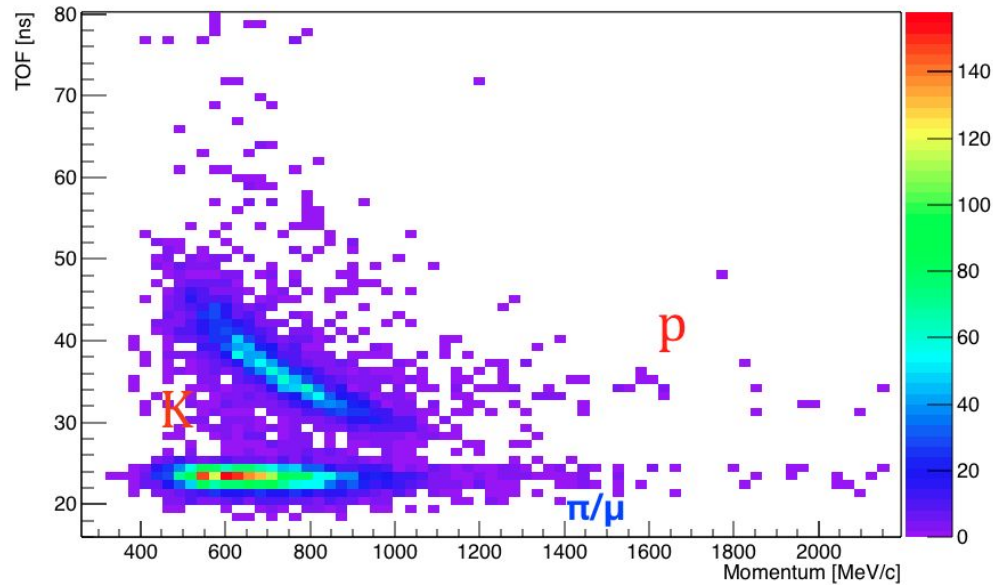
# Aerogel Pulse Area

- ❖ Pulse Area for each PMT with & without aerogel hit exist cuts applied



# TOF

- ❖ TOF allows for  $\pi/\mu$  & proton separation - Given the timing of the readout of the TOF + WC's you can do particle ID ( $\pi/\mu$ , p, K) before the particle enters your LArTPC.

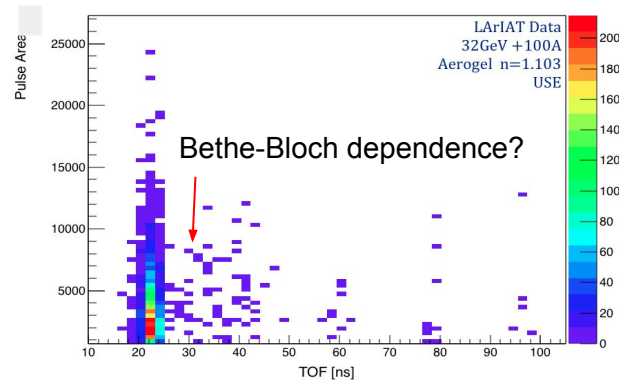
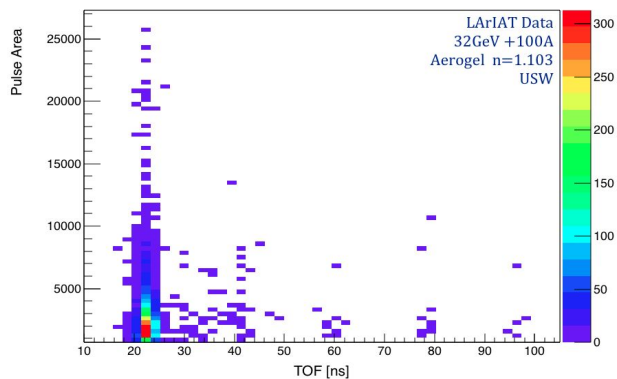


# Aerogel Pulse Area

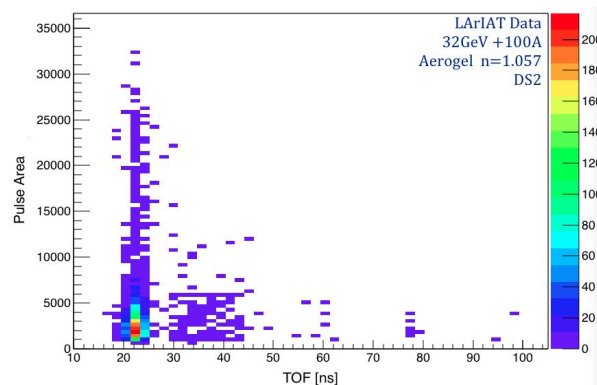
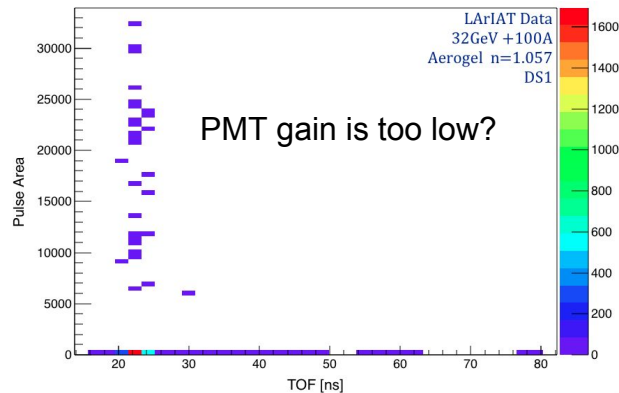
❖ Using runs 6258-6265(Positive Polarity)

❖

KEK Counter:



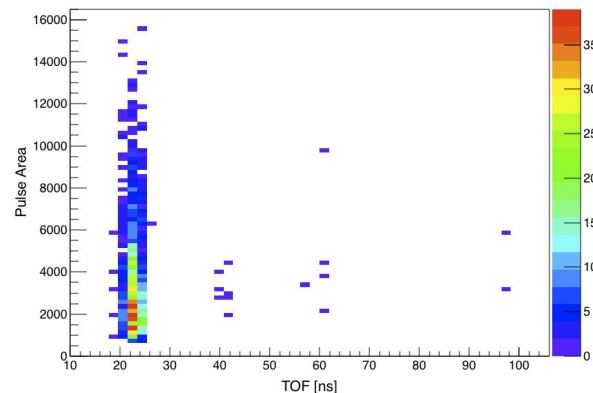
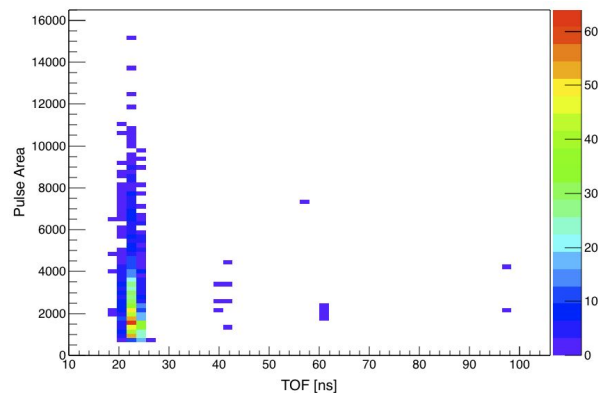
UT Counter:



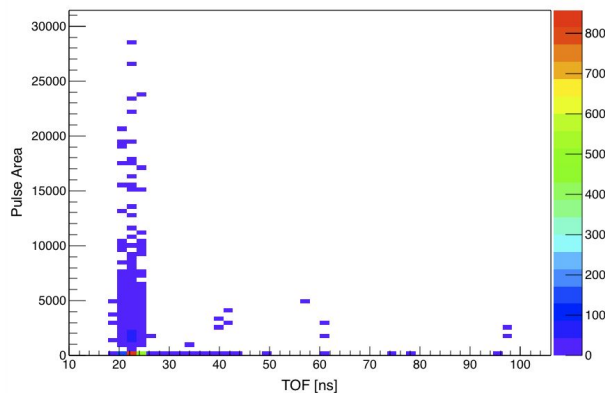
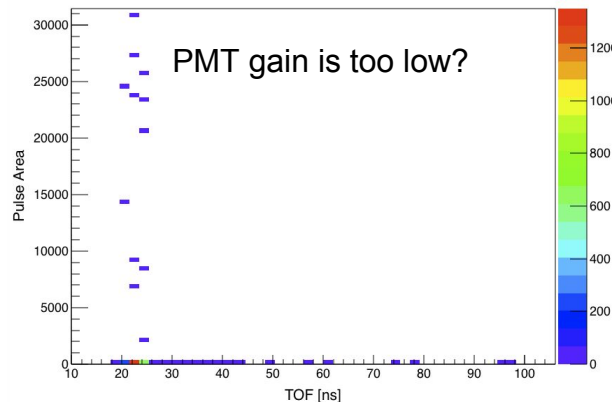
# Aerogel Pulse Area

- ❖ Using runs 6100-6329(Negative Polarity)
- ❖ We can focus on just on muons and pions separation analysis.

KEK Counter:



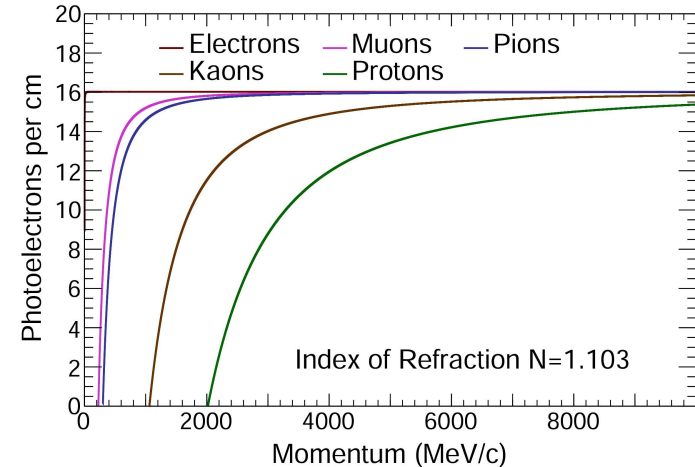
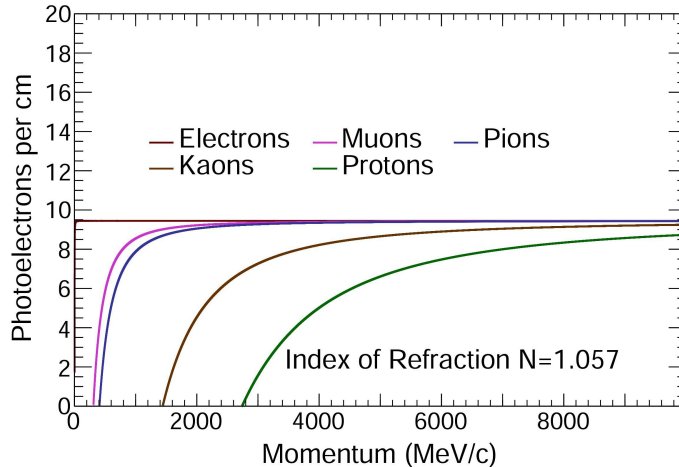
UT Counter:



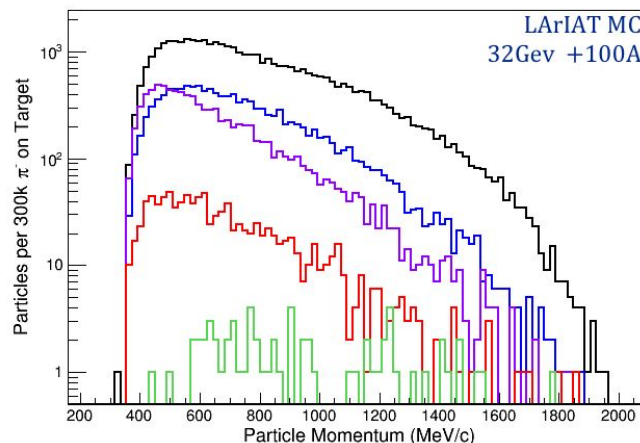
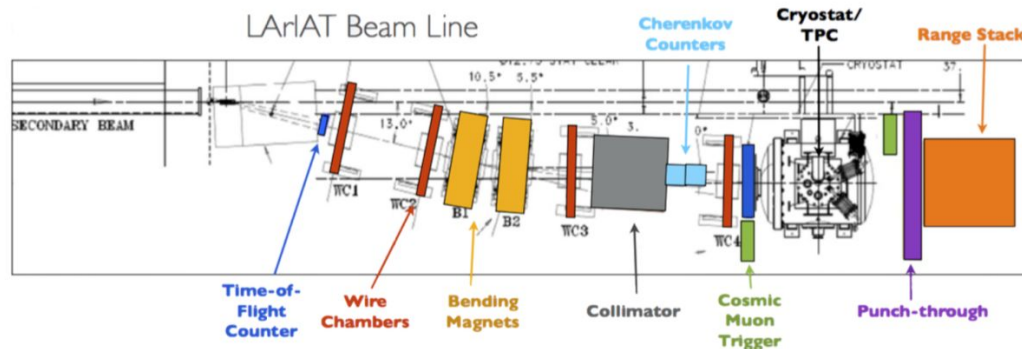
# Aerogel Analysis

- ❖ Aiming to separate muons and pions in a momentum range where muons emit Cherenkov radiation while pions do not.
- ❖ Different indices of refraction are sensitive to different momentum ranges.
- ❖ The combination of the two aerogel Cherenkov counters, pions and muon can be identified for  $p < 400 \text{ MeV/c}$

Aerogel Counter	$n=1.11$	$n=1.057$
200-300 MeV/c	$\pi$ $\mu$	$\pi$ $\mu$
300-400 MeV/c	$\pi$ $\mu$	$\pi$ $\mu$



# MC Beam Composition Studies



- ❖ How can we use beam simulation help understand the aerogel counters?
- ❖ How can we use aerogel counters help understand the beam simulation?



# MC Beam Composition Studies (Ideal Case)

❖ We can set constraints to the WC by requiring hits in the Aerogel Counter.

❖ We can assume efficiencies for muons and pions to be:

$n=1.05$

0% for  $0 < p_\mu < 310\text{MeV}$ , 100% for  $310\text{MeV} < p_\mu < \infty$

0% for  $0 < p_\pi < 440\text{MeV}$ , 100% for  $440\text{MeV} < p_\pi < \infty$

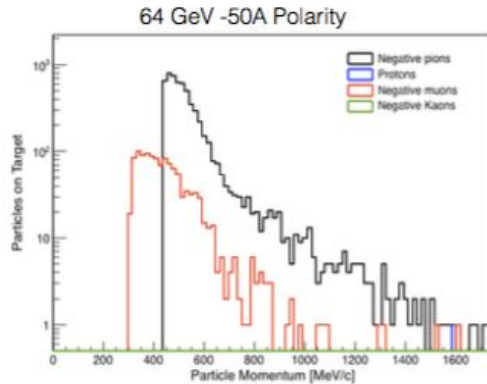
$n=1.103$

0% for  $0 < p_\mu < 220\text{MeV}$ , 100% for  $220\text{MeV} < p_\mu < \infty$

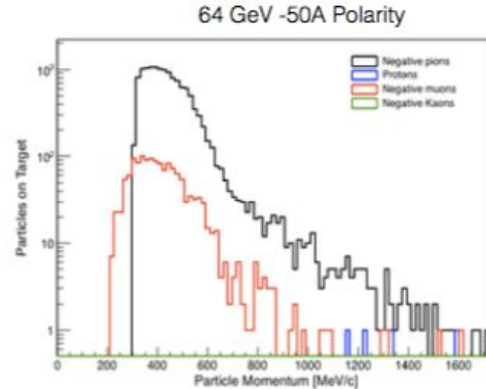
0% for  $0 < p_\pi < 310\text{MeV}$ , 100% for  $310\text{MeV} < p_\pi < \infty$

# MC Beam Composition Studies (Ideal Case)

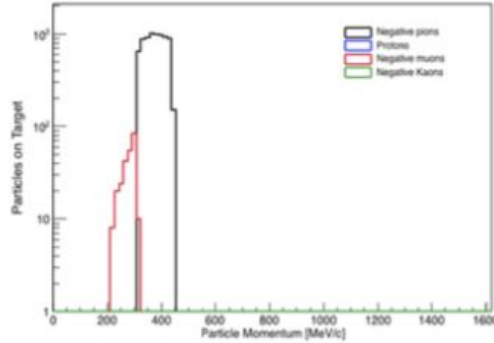
Requiring a hit in the  $n=1.057$  counter



Requiring a hit in the  $n=1.103$  counter

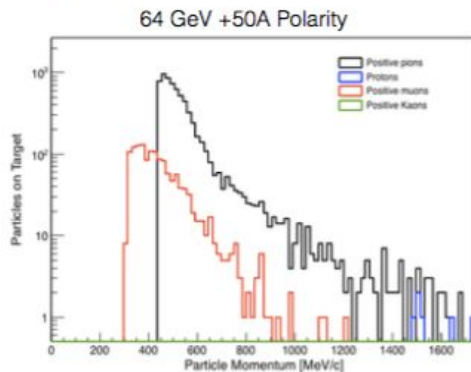


Requiring a hit in the  $n=1.103$  detector but not the  $n=1.057$  detector

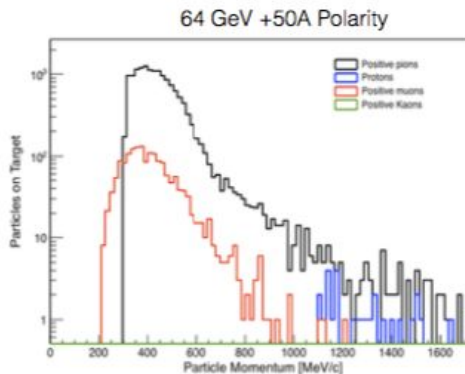


# MC Beam Composition Studies (Ideal Case)

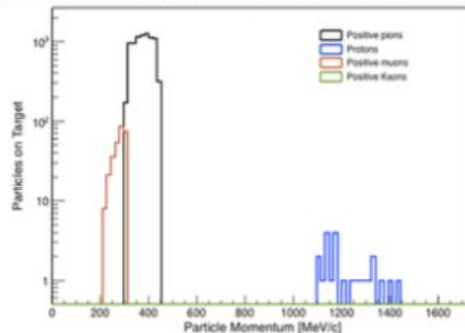
Requiring a hit in the  $n=1.057$  counter



Requiring a hit in the  $n=1.103$  counter

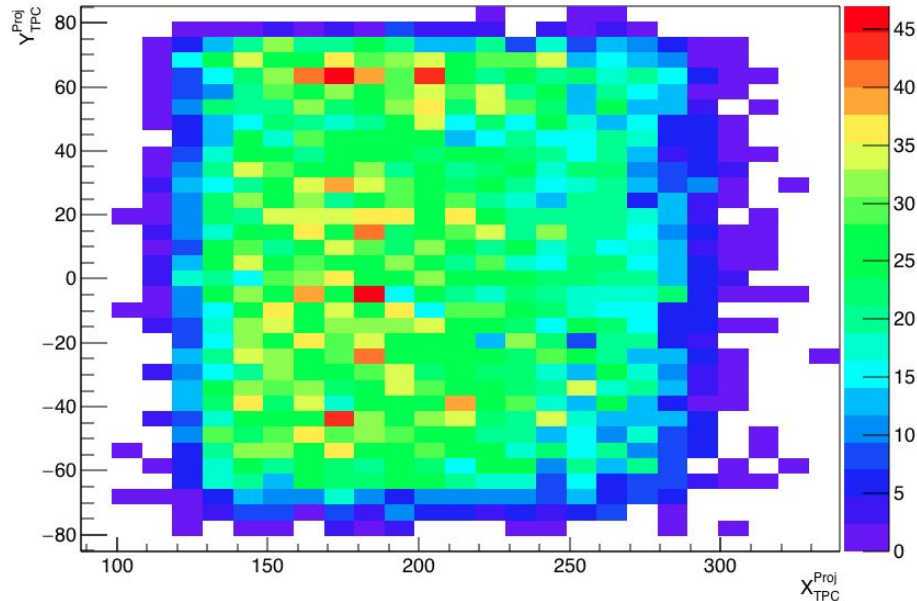


Requiring a hit in the  $n=1.103$  detector but not the  $n=1.057$  detector



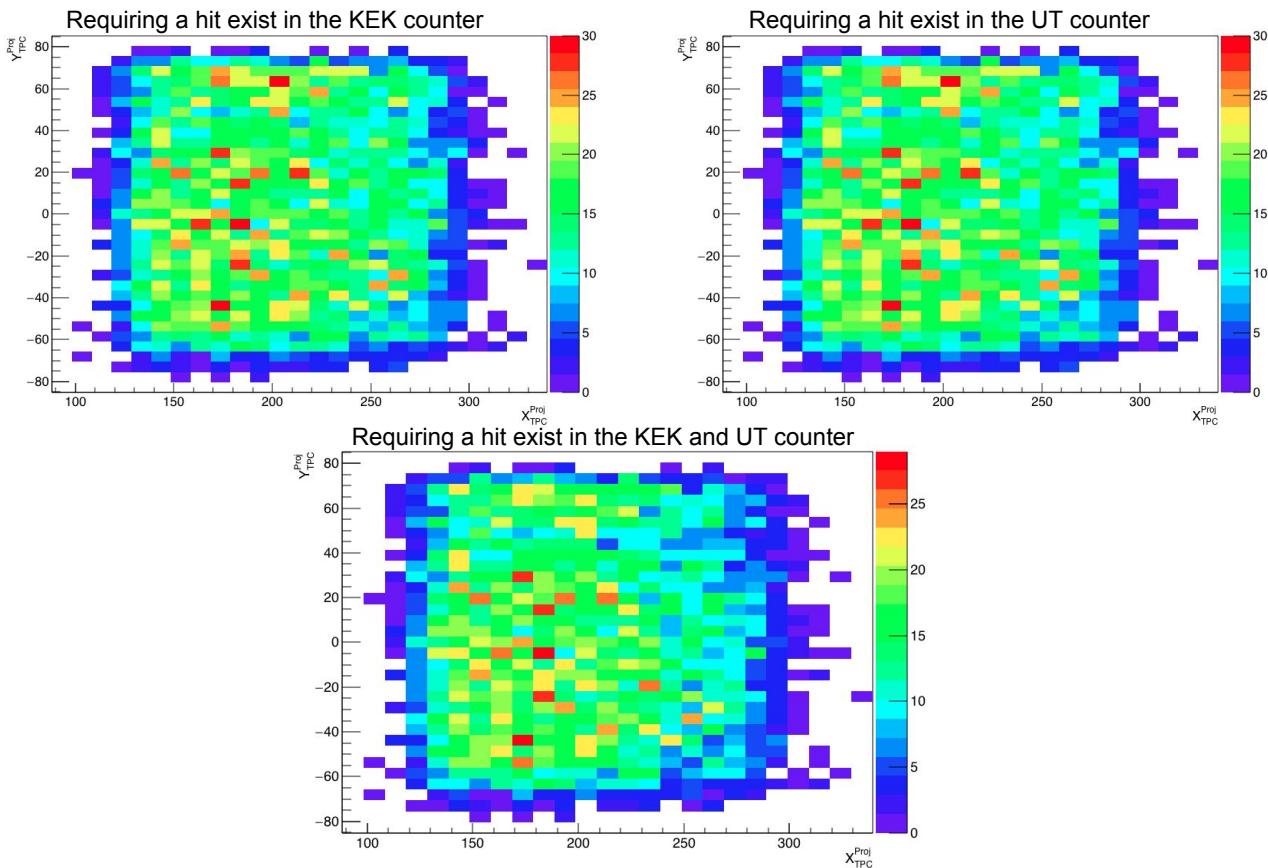
# WC Information

- ❖ Getting the X and Y position from the WC of a track at the TPC front face.
- ❖ Working on projection of WC tracks to aerogel counters.



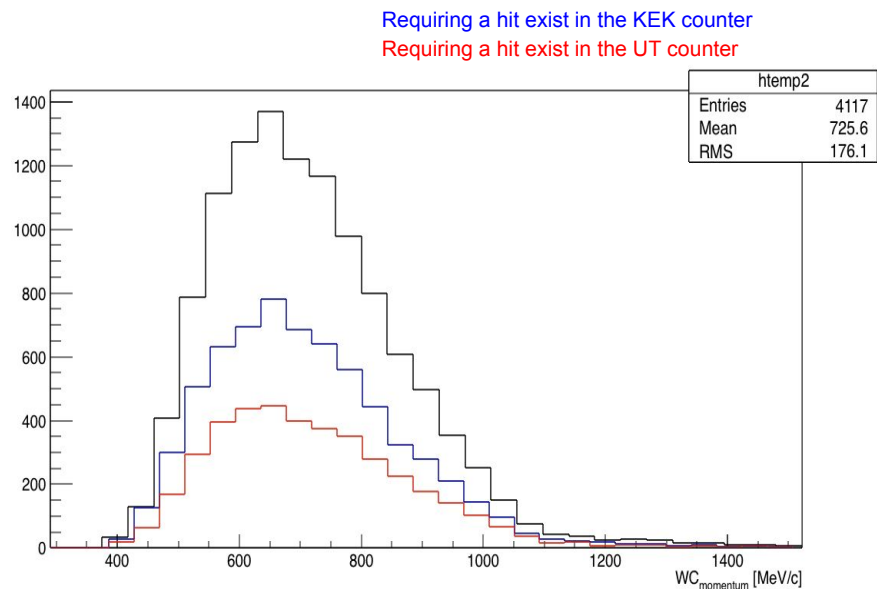
# WC & Aerogel

- ❖ Getting the X and Y position from the WC of a track at the TPC front face.



# WC & Aerogel

- ❖ Total WC momentum with Aerogel hitexist requirements
- ❖ This is positive polarity data with no cuts to get rid of protons.
- ❖ This is 100A data where all muons and pions should be above Cherenkov threshold.
- ❖ Investigation with negative polarity data is also in progress



# Work in progress

- ❖ Scanning over remaining negative and positive polarity data to increase statistics and see if can have a better look at the Bethe-Bloch dependence.
- ❖ Calculate the efficiencies for detecting pions vs protons for pulse area versus TOF.
- ❖ We can now get the position of hits for each wire chamber.
- ❖ Next: I will use the wire chamber information in the anatree is able to tell us the X and Y position of a particle in WC3 and WC4 to estimate the position of particles passing through the aerogel counters. The calculate the efficiencies for each aerogel counter for hints of separation.
- ❖ The aerogel system was not part of our beamline survey. Will is on shift 5/6-5/15

# Backup - Aerogel Codes in the LArIAT Software

<https://cdcvs.fnal.gov/redmine/projects/lardbt/repository>

lariatsoft/LArIATRecoModule/AerogelCherenkovCounterSlicing\_module.cc

lariatsoft/LArIATRecoAlg/AGCounterAlg.cxx

lariatsoft/LArIATRecoAlg/AGCounterAlg.h

lariatsoft/LArIATDataProducts/AGCounter.cxx

lariatsoft/LArIATDataProducts/AGCounter.h

lariatsoft/LArIATANaModule/AnaTreeT1034\_module.cc